

What is claimed is:

- 1 1. A secure communication system comprising:
  - 2 a plurality of geographic cells, each cell being
  - 3 associated with a specific geographic area and
  - 4 having a cell cryptographic key for secure
  - 5 communications with devices located within the
  - 6 cell; and
  - 7 a key management center that determines an
  - 8 anticipated cell path of a mobile device from a
  - 9 current cell to a destination cell and
  - 10 distributes to the mobile device a set of
  - 11 cryptographic keys necessary to permit secure
  - 12 communications for the mobile device within each
  - 13 cell along the anticipated cell path.
- 1 2. A system according to claim 1, further comprising:
  - 2 a hierarchical tree having a root node, a plurality
  - 3 of internal nodes, and a plurality of terminal
  - 4 leaf nodes, the root node and each internal node
  - 5 having an associated node cryptographic key for
  - 6 secure communication with lower nodes in the
  - 7 tree, each leaf node being associated with a
  - 8 specific geographic cell.
- 1 3. A system according to claim 2, wherein the
- 2 cryptographic key of each node below the root node is
- 3 derived by applying a mathematical function to the
- 4 cryptographic key of the next higher level node.

1 4. A system according to claim 2 wherein the mobile device  
2 knows the cryptographic key of each node in the tree on a  
3 direct path back to the root node.

1 5. A system according to claim 2, wherein at least one  
2 hierarchical level of the tree uses a structure of at  
3 least three dimensions to connect to nodes in the next  
4 lower hierarchical level.

1 6. A system according to claim 1, wherein the set of  
2 cryptographic keys distributed to the mobile device  
3 includes keys that are valid for a restricted period of  
4 time based on the anticipated cell path.

1 7. A system according to claim 1, wherein the set of  
2 cryptographic keys contains the minimum number of keys  
3 necessary to permit secure communications for the mobile  
4 device within each cell along the anticipated cell path,  
5 but no other cells.

1 8. A method of secure communication comprising:  
2 providing a plurality of geographic cells, each cell  
3 being associated with a specific geographic area  
4 and having a cell cryptographic key for secure  
5 communications with devices located within the  
6 cell;  
7 determining an anticipated cell path of a mobile  
8 device from a current cell to a destination  
9 cell; and  
10 distributing to the mobile device a set of  
11 cryptographic keys necessary to permit secure

12                   communications for the mobile device within each  
13                   cell along the anticipated cell path.

1    9.    A method according to claim 8, further comprising:  
2                   arranging a hierarchical tree having a root node, a  
3                   plurality of internal nodes, and a plurality of  
4                   terminal leaf nodes, the root node and each  
5                   internal node having an associated node  
6                   cryptographic key for secure communication with  
7                   lower nodes in the tree, each leaf node being  
8                   associated with a specific geographic cell.

1    10.   A method according to claim 9, wherein the  
2                   cryptographic key of each node below the root node is  
3                   derived by applying a mathematical function to the  
4                   cryptographic key of the next higher level node.

1    11.   A method according to claim 9, wherein the mobile  
2                   device knows the cryptographic key of each node in the  
3                   tree on a direct path back to the root node.

1    12.   A method according to claim 9, wherein at least one  
2                   hierarchical level of the tree uses a structure of at  
3                   least three dimensions to connect to nodes in the next  
4                   lower hierarchical level.

1    13.   A method according to claim 8, wherein the set of  
2                   cryptographic keys distributed to the mobile device  
3                   includes keys that are valid for a restricted period of  
4                   time based on the anticipated cell path.

1 14. A method according to claim 8, wherein the set of  
2 cryptographic keys contains the minimum number of keys  
3 necessary to permit secure communications for the mobile  
4 device within each cell along the anticipated cell path,  
5 but no other cells.

1 15. A computer program product for use on a computer system  
2 for secure communication in a computer network, the  
3 computer program product comprising a computer usable  
4 medium having computer readable program code thereon, the  
5 computer readable program code comprising:

6 program code for providing a plurality of geographic  
7 cells, each cell being associated with a  
8 specific geographic area and having a cell  
9 cryptographic key for secure communications with  
10 devices located within the cell;  
11 program code for determining an anticipated cell path  
12 of a mobile device from a current cell to a  
13 destination cell; and  
14 program code for distributing to the mobile device a  
15 set of cryptographic keys necessary to permit  
16 secure communications with the mobile device  
17 within each cell along the anticipated cell  
18 path.

1 16. A computer program product according to claim 15,  
2 further comprising:

3 program code for arranging a hierarchical tree having  
4 a root node, a plurality of internal nodes, and  
5 a plurality of terminal leaf nodes, the root  
6 node and each internal node in the tree having

7 an associated node cryptographic key for secure  
8 communication with lower nodes in the tree, each  
9 leaf node being associated with a specific  
10 geographic cell.

1 17. A computer program product according to claim 16,  
2 wherein at least one hierarchical level of the tree uses a  
3 structure of at least three dimensions to connect to nodes  
4 in the next lower hierarchical level.

1 18. A computer program product according to claim 17,  
2 wherein the at least one hierarchical level is the level  
3 in the tree immediately above the leaf nodes.

1 19. A computer program product according to claim 15,  
2 wherein the set of cryptographic keys distributed to the  
3 mobile device includes keys that are valid for a  
4 restricted period of time based on the anticipated cell  
5 path.

1 20. A computer program product according to claim 15,  
2 wherein the set of cryptographic keys contains the minimum  
3 number of keys necessary to permit secure communications  
4 for the mobile device within each cell along the  
5 anticipated cell path, but no other cells.